entities to each other may be arrived at by considering the relations which they bear to points, we may of course consider their relations without reference to points. Thus the system which consists wholly of straight lines is one composed of entities which are undistinguished from each other, and are such that pairs of those entities are of two sorts, viz. two straight lines cut or do not cut each other; and these two sorts of pairs are distributed through the system in accordance with definite laws.

Such considerations as these apply, not merely to straight lines, curves, surfaces, &c., but to all other entities which are dealt with by the geometrician. Vectors, quaternions, matrices, and even algebras, are as individuals all mere entities, and owe their properties to the fact that they bear certain relations to the entities previously referred to, and to each other; and all that is essential in these relations depends merely on the fact that certain individuals, pairs, triads, &c., and aspects of these, are distinguished from each other, and certain undistinguished, and have a specific distribution. Here therefore, also, it is "form" in the sense in which I have defined that word, and "form" only, which is under consideration.

In the same way terms, classes, syllogisms, and other logical conceptions are all mere entities; and all that is essential in their properties, so far as the exact thought of the formal logician is concerned, depends upon the fact that they compose systems possessing "form," *i.e.* a definite distribution of distinguished and undistinguished collections of entities, and of aspects of those collections.

A system of entities under consideration in any investigation will usually comprise entities of many sorts, some of which are taken into account merely for the purpose of facilitating the study of the properties of others. Algebras, and operations such as quaternions, are examples of entities thus added by the geometrician to a system of points, lines, curves, &c., in order to aid in arriving at the properties of the latter. By thus adding "auxiliary" entities to a system, we may also greatly simplify the definition of its "form"; so that a system which would otherwise be defined only by reference to the distribution of aspects, or of collections of a large number of entities, can be defined by definitions which refer merely to the distribution of collections of a small number of entities, and make no allusion to aspects. In fact, it may be shown that, by the addition of suitable entities, the "form" of any system of entities whatever may be defined by specifying merely that certain *individual* entities, and certain *pairs* of those entities, are like and certain unlike.

The light which is thrown by the foregoing investigations will, I hope, be sufficient to insure the appreciation, if not the acceptance, of the following general definition of the subject-matter of exact thought:—

Whatever may be the true nature of things, and of the conceptions which we have of them (into which points we are not here concerned to inquire), in the operations of exact thought they are dealt with as a number of separate entities.

Every entity is distinguished from certain entities, and (unless unique) is undistinguished from others. In like manner every collection of entities is distinguished from certain collections of entities, and (unless unique) is undistinguished from others; and every aspect of a collection of entities is distinguished from certain aspects of collections, and (unless unique) is undistinguished from others.

Every system of entities has a definite "form," due (1) to the number of its component entities, and (2) to the way in which the distinguished and undistinguished entities, collections of entities, and aspects of collections of entities, are distributed through the system.

The peculiarities and properties of a system of entities depend, so far as the processes of exact thought are concerned, upon the particular "form" it assumes, and are independent of anything else.

It may seem in some cases that other considerations are involved besides "form"; but it will be found on investigation that the introduction of such considerations involves also the introduction of fresh entities, and then we have merely to consider the "form" of the enlarged system.

If the definition of the subject-matter of exact thought which I have thus ventured to formulate be an accurate one, it will be obvious that there are divisions at present maintained between different branches of exact science which must be regarded as unnecessary and arbitrary; the only differences which should be treated as material being such as are due to differences of "form." These differences are certainly not such as to justify the isolation and separate study of individual systems, without any attempt to fix the position which each holds in the general body of possible systems, or to ascertain the exact points in which each resembles or differs from other systems of the whole body. The scientific study of each system must involve that of the properties common to all, of the general laws regulating the distribution of distinguished and undistinguished collections and aspects of collections in systems of any "form," and of the possibilities of variety in their "forms."

A. B. KEMPE.

NOTES.

THE retirement of Sir Gabriel Stokes from the Presidency of the Royal Society is to be taken as an occasion for the expression of the Fellows' high appreciation of his services. He has held office, either as one of the secretaries or as president, for thirty-six consecutive years; and it is unnecessary to say how much the Royal Society has benefited by his labours during that long period. It is thought that the most suitable way of marking the present occasion would be to obtain a good portrait of Sir Gabriel for the gallery of the Society; and an influential committee has been appointed to make the necessary arrangements.

AT a meeting of the City side of the Gresham Committee at Mercers' Hall on Monday, Mr. Karl Pearson, Professor of Mechanics and Applied Mathematics in University College, was elected Gresham Lecturer in Geometry, in succession to the Dean of Exeter.

DR. J. JAGOR, the eminent ethnographical traveller, intends to make a scientific tour in British India. Remembering his researches forty years ago, many men of science in Berlin take much interest in his present plans.

THE German Colonial Society have forwarded a number of books on tropical plants to Emin Pasha to further his scientific researches, as he lately complained (in a letter to Prof. Schweinfurth) of his want of works of reference. Prof. Noack has lately received a letter from the Pasha, dated Tabora, the middle of August. He then intended to leave for Uramba in four or five days, on his way to Lake Tanganyika.

AT a meeting of the Royal Botanic Society on Saturday, the Secretary answered various questions as to the destructive action of fogs on plants. He said it was most felt by those tropical plants in the Society's houses of which the natural habitat was one exposed to sunshine. Plants growing in forests or under tree shade did not so directly feel the want of light; but then, again, a London or town fog not only shaded the plants, but contained smoke, sulphur, and other deleterious agents, which were perhaps as deadly to vegetable vitality as absence of light. Soft, tender-leaved plants, and aquatics, such as the *Victoria regia*, suffered more from fog than any class of plants he knew.

On Monday, Mr. T. G. Pinches read a paper before the Royal Asiatic Society, on the newly-discovered version of the story of the creation. He had had the good fortune, in the course of his investigations into the contents of the unregistered tablets in the British Museum, to find in one of them, brought home by Mr. Rassam in 1882, a still earlier version than that which the late Mr. George Smith had translated. It was a bilingual tablet, the text being Akkadian, and the gloss Assyrian; and while the date of the tablet itself was, like the rest of those in Assur-bani-pal's library, not older probably than 650 B.C., the Akkadian text was, in his opinion, an exact copy of an older document, which had, in all probability, been put into its present shape 3000 B.C., or even earlier. One side, the obverse, is devoted to the creation story. The other, the reverse, is simply an incantation form for the purification of the great temple tower E-zida, now so well known as the mound called Birs-Nimrud. The text might be roughly divided into three paragraphs or sections of about ten lines each. The first describes the time when nothing was, neither "the glorious house of the gods," nor plants, nor trees, nor cities, nor houses, no, not even the abyss (Hades) nor Eridu (regarded by the author as Paradise). The second section describes the making of Paradise with its temple tower E-Sagila, founded within the abyss. Then was Babylon made, and the gods, and the land, and the heavens, and mankind. The third section then proclaims the creation of animals, plants, and trees (in that order), of the Tigris and of the Euphrates. The fourth records the building of cities and houses. Of all except the last, Merodach, the god, seems to be the active creator, and he is also to be understood as the builder, through men, of the cities, &c. Mr. Pinches pointed out several interesting words and forms occurring in this oldest form of the creation account, which had subsequently assumed so many diverging shapes. A discussion followed, more especially on the word Adam, rendered by Mr. Pinches "foundations" (of earth), but by Dr. Zimmern "living things." This was probably the origin of the Hebrew word Adam.

According to the *Journal de la Chambre de Commerce de Constantinople*, the greatest electric project which has yet been suggested is being planned—the construction of a line from St. Petersburg to Archangel. The electric current would be supplied by a series of generating stations distributed along the line. It is estimated that the cost, including the rolling stock, would be 46,509 francs per kilometre.

The forty-first volume of the *Izvestia* of the Moscow Society of Friends of Natural Science contains a valuable review of the work done in zoology, anatomy, and embryology in connection with the Society during the last twenty-five years.

Natural History and Ethnographical Museums have been opened lately in several towns of East Siberia; and a like institution has now been established at Tobolsk. It contains most valuable ethnographical collections to illustrate the life of the Ostyaks and the Samoyedes, as also a very complete herbarium of the Tobolsk flora, and a collection of books, pamphlets, &c., on the region.

At a recent meeting of the Paris Academy of Medicine, M. Motais, of Angers, maintained that myopia, or short-sightedness, is one of the products of civilization. An unexpected proof of this view was found in the condition of the eyes of wild beasts, such as tigers, lions, &c. M. Motais, having examined their eyes by means of the ophthalmoscope, discovered that animals captured after the age of 6 or 8 months are, and remain, hypermetropic, while those who are captured earlier, or, better still, are born in captivity, are myopic. This short-sightedness is evidently induced by artificial conditions of life.

M. A. Berthoule has contributed to the *Revue des Sciences Naturelles Appliquées* a series of papers, well illustrated, on the lakes of the Auvergne region, and their fauna, natural or introduced. He considers that new species might be placed in many of these lakes, and, if properly attended to, would yield large profits to pisciculturists.

The curious idea of preserving dead bodies by a galvano-plastic method is not new, but we note that a Frenchman, Dr. Variot, has been lately giving his attention to it (*La Nature*). To facilitate adherence of the metallic deposit, he paints the skin with a concentrated solution of nitrate of silver, and reduces this with vapours of white phosphorus dissolved in sulphide of carbon, the skin being thus rendered dark and shiny. The body is then ready for the electric bath, which is served by a thermo-electric battery, giving a regular adherent deposit of copper if the current is properly regulated. With a layer of $\frac{1}{2}$ to $\frac{3}{4}$ mm. the envelope is solid enough to resist pressure or shock. Dr. Variot further incinerates the metallic mummy, leaving holes for the escape of gases. The corpse disappears, and a faithful image or statue remains.

Mr. Nathaniel Waterall, Waddon, Croydon, writes to us that, in one of the outhouses in the garden belonging to the house in which he resides, a robin's nest was found some time ago in a flat hand-basket, hanging on the side of the wall. In the nest there were four young ones, recently hatched. They were allowed to remain until their time came to fly away. The basket had been in the same position for a considerable time.

Prof. E. A. Kirkpatrick contributes to the *Evening Gazette* (Mass., U.S.), a paper in which he shows how parents—mothers especially—might do good service to psychology by recording "certain facts of child development." He suggests that they should devote particular attention to the growth of the power of speech. They ought, he thinks, to keep two lists of words—one containing all words articulated by the child, with indications as to how they are pronounced; the other, all words used "understandingly." The first list would indicate the common difficulties encountered in learning to articulate, and an examination of a sufficient number might make it possible to determine whether there really are "general laws of mispronunciation." The second list would show the intellectual progress of the child as it learns new words, and learns to use old ones with increasing accuracy, and to put them together into phrases and sentences. Words that are invented by the child, and those used in a sense different from the ordinary meaning, are especially interesting, and throw considerable light on the subject of how children classify and generalize. Prof. Kirkpatrick proposes that separate sheets shall be kept for each week, or perhaps for each month in the case of the articulating vocabulary. No confusion will then result, and on the back of the sheets may be given the peculiar meanings attached to words, the earlier attempts at putting words together, the later sentences of interest, especially those showing the characteristic grammatical errors, and other items. He is of opinion that the comparison of a number of such vocabularies would help to solve several interesting problems; and he expresses a hope that those who have begun, or think of beginning, the preparation of lists will send him the record for several months, before the middle of next May. Anything of scientific value that may be thus reached will be published, and along with it will be given "the names of those by whose patient observation it has been obtained."

Prof. Brückner, of Berne, has recently called attention to the existence of climatological periods of about 35 years for the whole globe (more marked in the interior of continents). The years 1700, 1740, 1780, 1815, 1850, and 1880 appear as centres of cold, wet periods; while the years 1720, 1760, 1795, 1830, and 1860 are centres of warm, dry periods. During the warm periods the passage of oceanic air to the continent has been hindered, and during the cold it has been favoured, increased rainfall occurring in the latter case.

IT is stated that another meteorological station has just been added to the list of those in telegraphic communication with the Observatory at Si-ka-wei near Shanghai—namely, at Tientsin. M. Chapsal, whose services in promoting and improving the present system of semaphore signalling and meteorological observations are deserving of great praise, requested M. Ristelhueber, the French Consul-General at Tientsin, to use his influence with the Director-General of Chinese Telegraphs, to procure the free transmission of the necessary telegrams, with the result that permission has been obtained. The observations at Tientsin, made by Mr. Bellingham, will probably be of much value.

WE have received a small pocket-book, published by Alfred Watkins, Hereford, on exposure notes, for use with the Watkins exposure meter. This meter seems to be of a very ingenious construction, and, according to the accounts we have read about it, should be found a very serviceable appendage to the photographic kit. The instrument is very neat and compact, being only 2½ inches long and 1¾ inches in diameter, and consists of a combination of a bromide of silver actinometer, a chain pendulum for timing the exposure, and a set of calculating rings, each carrying a pointer. If each of these rings be set for the correct value of the factors indicated, a fifth pointer automatically indicates the correct time of exposure in seconds or in fractions of a second, as the case may be. In this note-book, full instructions are given as to the method of using it, followed by 60 pages in which notes on exposure, values of the factors, and other details may be inserted. In addition to the above, at the end are inserted various hints and jottings which should be found useful to the many photographers, both amateur and professional, who will use this note-book.

THE Belgian Consul-General at Singapore, in a report quoted in the new number of the *Board of Trade Journal*, says that rubies and sapphires abound in the Siamese provinces of Chantaboun and Battambang. Several mines have been worked since a remote period by the natives, but for a long time they produced for the most part only stones of little value. It was in 1874 that the first mine of sapphires of good quality was discovered by a native huntsman in the environs of Chantaboun. The place was very difficult of access, so that the news of the discovery spread slowly. Rangoon being still at that time the nearest market to Siam for the sale of precious stones, the Burmans were the first to know of the existence of the new mine by the stones which were offered for sale at Rangoon. Some went here, and the large sums which they brought on their return from the sale of their produce brought about a movement of very active emigration for the same destination during the years 1878 and 1879. The new-comers discovered several mines as rich as the first. But there, as at Bantaphan, fevers made such sad ravages in the ranks of the workers, that in 1880 the number of arrivals decreased in considerable proportions, and at the present time the population of these mines, which once reached the figure of 10,000, consists of a few Pegu Toung-Thons, who can ward off better than other races the ills resulting from the terrible climate of the country. Rubies, onyx, and jades are also found in considerable quantities in the province of Chantaboun, but their quality leaves much to be desired. Battambang is as rich in precious stones as Chantaboun, and it is stated that recently diamonds have been found near the frontier of Cambodia; but the mines of this province are almost abandoned because of the insalubrity of the climate, and the want of protection for foreign workers.

THE canalization of the immense marshes of Pinsk, in West Russia, is rapidly going on. No less than 185 square miles of marshes have been drained on the banks of the Pripet, and more than 7,000,000 acres of meadow-land have been reclaimed in this way. Forests which formerly remained inaccessible and valueless, are now easy of access, and begin to be profitable.

A SERIES of experiments upon the synthetical production of cyanogen compounds by the mutual action of charcoal, gaseous nitrogen, and alkaline oxides or carbonates, at high temperatures and under great pressure, are described by Prof. Hempel in the new number of the *Berichte*. Bunsen and Playfair long ago showed that when charcoal and potassium carbonate are heated to redness in an atmosphere of nitrogen, a certain quantity of cyanide of potassium is formed. Since that time Margueritte and Sourdeval have further shown that barium carbonate may be used in place of the potash, and that the barium cyanide produced may be again decomposed by steam into ammonia and barium carbonate. These reactions afforded a theoretically continuous process for the conversion of atmospheric nitrogen into ammonia, a process which, if it could only be worked on the large scale, would doubtless be of immense value. Unfortunately, however, only small proportions of the substances appear to enter into the reaction at ordinary pressures, hence the yield is not sufficiently large to render the process economical. Prof. Hempel, however, by means of a simple pressure apparatus, has shown that the reaction is very much more complete, and when potash is used very energetic, under the pressure of sixty atmospheres. His apparatus consists of a strong cylinder closed at one end, and worked out of a single block of steel. The steel top screws tightly down, so as to form a closed chamber, and is pierced with two apertures—one for connection with the compressing-pumps, and a second to admit the passage of an insulated copper rod. Within the steel cylinder is placed a smaller cylinder of porcelain, in which the mixture of the alkaline oxide or carbonate and charcoal is placed. Through the centre of this mixture passes a rod of charcoal, which is connected above with the copper rod and below with the steel cylinder itself, in such a manner that when the wires from a strong battery or dynamo are connected with the projecting end of the copper rod and the exterior of the steel cylinder respectively, the rod of charcoal becomes heated to redness. The pumps are then caused to force in nitrogen gas until the desired pressure is registered on the gauge. Experimenting in this manner it was found that the amount of barium cyanide formed in fifteen minutes under a pressure of sixty atmospheres was nearly four times that formed at ordinary atmospheric pressure; while in case of potassium carbonate the reaction was so energetic that in a few seconds the heated carbon rod itself was dissolved. Hence it is evident that the formation of cyanides by heating together alkaline carbonates and charcoal in an atmosphere of nitrogen is greatly accelerated by largely increasing the pressure under which the reaction occurs.

THE additions to the Zoological Society's Gardens during the past week include a Cape Hyrax (*Hyrax capensis*), an Areolated Tortoise (*Homopus areolatus*), a Galeated Pentonyx (*Pelomedusa galeata*), two Rough-scaled Lizards (*Zonurus cordylus*), six Dwarf Chameleons (*Chamæleon pumilus*), two Rufescent Snakes (*Leptodira rufescens*), three Smooth-bellied Snakes (*Homolosoma lutrix*), a Rufous Snake (*Ablabes rufulus*), a Ring-hals Snake (*Sepedon hæmachates*), a Robben Island Snake (*Coronella phocarum*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Common Fox (*Canis vulpes* ♂), British, presented by Mr. C. T. Stanhope Bilbrough; a Demoiselle Crane (*Grus virgo*) from North Africa, presented by Mrs. Wright; two Cactus Conures (*Conurus cactorum*) from Brazil, presented by Mr. H. C. Martin; two Common Mynahs (*Acridotheres tristis*) from India, presented by Mr. G. W. Blathwayt; two Snow Buntings (*Plectrophanes nivalis*), three Bramblings (*Fringilla montifringilla*), British, presented by Mr. J. E. Baldwin; a Broad-fronted Crocodile (*Crocodilus frontatus*) from West Africa, received in exchange.